Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/562
UNITED KINGDOM
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

RESEARCH IN BRITISH UNIVERSITIES RELATED TO NUCLEAR FUEL REPROCESSING

by

[*] G. R. Hall
[=] G. H. Nancollas
[o] D. G. Tuck
[*] F. L. D. Cloete
[▼] L. V. C. Rees
[▪] J. C. R. Turner
[+] G. C. Coggan
[x] J. E. Salmon
[+] S. Hartland
[*] M. Streat

Some research in British Universities related to the chemistry and technology of nuclear fuel aqueous reprocessing is described.

The breakdown of organic ion exchange resins when exposed to intense ionising radiation has been examined. Strong base resins, containing quaternary ammonium functional groups, lose strong base capacity by loss of tertiary amine, and gain weak base capacity by conversion of the quaternary to an amino group. Measurements are reported of capacity changes and decomposition product yields for several anion exchanger salt systems measured under both static and dynamic bed conditions. In strong nitric acid and under irradiation, the anion exchangers undergo severe damage to the polymer structure. Similar studies on cation exchangers have been made.

Inorganic ion exchange materials are known to be more stable to radiation than organic resins. A quantitative examination of properties of Linde Molecular Sieve 13-X, a synthetic zeolite, shows a remarkably high radiation stability with respect to its structure, sorption and cation exchange capacities. This material

[*] Department of Chemical Engineering and Chemical Technology, Imperial College, London, S.W.7

[+] Department of Chemical Engineering, University of Nottingham

[=] Chemistry Department, The University, Glasgow

[▼] Department of Chemistry, Imperial College, London, S.W.7

[x] Department of Chemistry, Battersea College of Technology, London, S.W.11

[o] Department of Chemistry, University of Nottingham

[▪] Chemical Engineering Department, University of Cambridge

possesses certain excellent ion exchange properties but is unstable in solutions of pH lower than 5. The exchange equilibria of a variety of cation and anion exchangers based on hydrous zirconia and thoria and on zirconium and thorium phosphates are reported. High specificity can be attained but commercial application is limited due to difficulties in preparing stable reproducible materials and to their limited stabilities in acid solution.

In studies of the chemistry of solvent extraction processes particular attention has been given to acid and neutral phosphate solvents and to the amines tri-n-octylamine and methyl-dioctylamine. Data for the extraction of acids and metal anionic species into these solvents is reported. A number of complexes of NpO_2^+ and NpO_2^{++} have been identified.

The electrolytic dissolution of uranium metal into nitric acid using a tubular dissolver is described. The new dissolver has several advantages over the more familiar basket dissolver. Recent theoretical studies on the dissolution of a cylindrical fuel element in a potential gradient are reported.

The influence of dimensional scale-up and operating variables on the performance of pulsed columns and mixer-settlers using aqueous-dispersed systems are considered. An important aspect of this work has been a fundamental study of coalescence.

Some techniques for continuous countercurrent contact of particulate solids with fluids are described, including a novel technique particularly suitable for processes operating under highly radioactive conditions. Results are reported on the hydrodynamics and mass transfer performance of small-scale equipment operating on ion exchange systems.